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L3: Entry 11 of 14   File: USPT   Jan 11, 2000

DOCUMENT-IDENTIFIER: US 6014381 A
TITLE: System and method for distributing information throughout an aircraft

Brief Summary Paragraph Right (10):
The present invention relates to a system and method for distributing audio and video
in a digital format throughout an aircraft. The system includes an Asynchronous
Transfer Mode ("ATM") network interconnected to a high speed, serial distribution
network propagating information in a format preferably in accordance with IEEE 1394
standards. The ATM network receives data in an analog format and digitizes the data
before propagation through the networks. Collectively, these digital networks support
the broadcast of audio and/or video in real-time as well as actual "video on demand"
services.

Drawing Description Paragraph Right (2):
FIG. 1 is a general diagram of the hybrid topology of the IFE system which includes an
ATM network and a serial distributed network having IEEE 1394 electrical standards
which collectively support the broadcast of media in real-time.

Detailed Description Paragraph Right (3):
Referring to FIG. 1, a block diagram of a preferred hybrid topology of an in-flight
entertainment ("IFE") system is shown. In general, the IFE system 200 comprises a first
digital network 210 coupled to a second digital network 280 through a plurality of
network bridge circuits 240-240.sub.n ("n" being a positive whole number), preferably
zone bridge units ("ZBUs") described below. The first digital network 210 transfers
information in a first digital format to the network bridge circuit 240 which converts
the information into a second digital format for transmission through the second
digital network 280. In this embodiment, the first digital network 210 is an
Asynchronous Transfer Mode ("ATM") network to provide point-to-point interconnection,
while the second digital network 280 is a high speed, serial distribution network
(e.g., a network operating in accordance with IEEE 1394 electrical standards) that
provides high-speed communication as well as broadcast capabilities. It is
contemplated, however, that other interconnect technologies may be used such as Fiber
channel, Ethernet and Token-Ring. However, these technologies are inferior in their use
on vehicles for the following reasons. Fiber channel is costly and a less established
technology. Ethernet is a point-to-point technology requiring substantial cabling for
its implementation. Token Ring is not well suited for video propagation due to speed
and latency constraints.

Detailed Description Paragraph Right (4):
The ATM network 210 includes a headend control system 211 coupled to an ATM switch unit
230. The headend control system 211 transmits information in the form of ATM cells
constructed in accordance with well-known network protocols such as Transmission
Control Protocol/Internet Protocol ("TCP/IP") or User Datagram Protocol/Internet
Protocol ("UDP/IP") as well as "IP over ATM" protocol (RFC-1577). The information is
routed from the headend control system 211 through the ATM switch unit 230 and into a
targeted ZBU (e.g., ZBU 240.sub.1). Within the targeted ZBU, the information is
converted to an IEEE 1394 format for propagation through the serial distribution
network 280 for subsequent delivery to one or more targeted end node(s) associated with
a set of SEUs (e.g., SEUs 250.sub.1 -250.sub.r, where "r" is a positive whole number)
coupled to the targeted ZBU. If necessary, the information is converted from digital to
analog at the SEUs.

Detailed Description Paragraph Right (5):
Additionally, the IFE system 200 enables information in an IEEE 1394 format to be
routed from an end node, to a SEU (e.g., SEU 250.sub.1), and then to a ZBU (e.g., ZBU
240.sub.1) associated with the SEU. Within the ZBU, the information is formatted for
transmission through the ATM network 210 as ATM cells. These ATM cells are transferred

to the ATM switch unit 230 and routed to the headend control system 211.

Detailed Description Paragraph Right (6):
Referring now to FIG. 2, a more detailed illustration of the hybrid topology of the IFE system 200 is shown. As indicated above, the IFE system 200 comprises the ATM network 210 coupled to the serial distribution network 280 operating in accordance with IEEE 1394 electrical standards. The plurality of ZBUs 240.sub.1 -240.sub.n, with the assistance of the ATM switch unit 230, provide the interface for coupling together these distinct digital networks 210 and 280.

Detailed Description Paragraph Right (12):
A detailed block diagram of the SIU 212 is illustrated in FIG. 3. A control processor 300 including memory is coupled to both a first bus (e.g., Peripheral Component Interconnect "PCI" bus) 305 and a second bus 310 (e.g., an Industry Standard Architecture "ISA" bus) for communicating with the other components within the SIU 212. A hard disk drive 315 is also coupled to the control processor 300. A keyline interface circuit 320 is coupled to the ISA bus 310 to receive and send keyline control signals. An ATM network interface 325 is coupled to the ATM switch unit 230 and to the PCI bus 305, thereby allowing the SIU 212 to communicate over the ATM network 210. An audio/video multiplexer 330 is coupled to receive analog data from one or more analog input devices. The audio/video multiplexer 330 is also coupled to an MPEG encoder circuit 335 and to the ISA bus 310. The MPEG encoder circuit 335 is coupled to the PCI bus 305. A power control and power supply circuit 340 is coupled to receive power control keyline signals and to provide power to the components within the SIU 212. A RS-485 standard interface circuit 345 is coupled to communicate with at least the video reproduce units ("VRUs") and an observation video camera. The RS-485 standard interface circuit 345 is also coupled to the ISA bus 310. Alternatives, an IEEE 1394 format may be used to interconnected the observation camera, VRUs and the like to the ISA bus 310.

Detailed Description Paragraph Right (15):
Referring back to FIG. 2, the ZBUs 240.sub.1 -240.sub.n function as a bridge between the high speed, fiber optic ATM network 210 and the serial distribution network 280 for the particular zones (or areas) of the vehicle. More specifically, each ZBU is responsible for managing serial distribution network 280 for a zone within the vehicle including IEEE 1394 bus management and IEEE 1394 bandwidth resource management. Each ZBU is further responsible for mapping IEEE 1394 addressing to ATM addressing as well as supporting broadcast and multicast functionality between the ATM network 210 and serial distribution network 280 for that zone. The ZBUs 240.sub.1 -240.sub.n are coupled together through IEEE 1394 standard digital cables.

Detailed Description Paragraph Right (17):
Referring again back to FIG. 2, the serial distribution network 280 includes a plurality of groups of SEUs 255.sub.1 -255.sub.r, each group being coupled to one of the plurality of ZBUs 240.sub.1 -240.sub.n. Each group of SEUs 255.sub.1 -255.sub.r (e.g., a first group 255.sub.1) includes a plurality of SEUs 250.sub.1 -250.sub.m ("m" being a positive whole number), coupled preferably in series through a differential, copper wire bus 270.sub.1 operating in accordance with IEEE 1394 electrical standards. The IEEE 1394 bus 270.sub.1 and identical buses 270.sub.2 -270.sub.n support data transfers at a rate of approximately 200 Mbps, half-duplex.

Detailed Description Paragraph Right (19):
As described above, the serial distribution network 280 is formed between the ZBUs 240.sub.1 -240.sub.n and the SEUs for data communications through preferably IEEE 1394 buses 270.sub.1 -270.sub.n within a zone. The IEEE standard entitled, "P1394 Standard For A High Performance Serial Bus," Draft 8.01v2, Jul. 7, 1995, is an international standard for implementing an inexpensive high-speed serial bus architecture which supports both asynchronous and isochronous format data transfers. Isochronous data transfers are real-time transfers which take place such that the time intervals between significant instances have the same duration at both the transmitting and receiving ends. Each packet of data transferred isochronously is transferred in its own time period. The IEEE 1394 standard bus architecture provides multiple channels for isochronous data transfers. A multiple bit channel number is broadcast with the data to ensure proper reception and allow multiple, simultaneous isochronous data transfers across the bus structure. Asynchronous transfers are traditional data transfer operations which take place as soon as possible and transfer an amount of data from a source to a destination.

Detailed Description Paragraph Right (20):

The IEEE 1394 standard provides a high-speed serial bus for interconnecting digital devices thereby providing a universal I/O connection. The IEEE 1394 standard defines a digital interface thereby eliminating the conversion of digital data to analog data before it is transmitted across the bus. Correspondingly, digital data will be received from the bus such that analog-to-digital conversion is not required. Devices can be added and removed from an IEEE 1394 bus while the bus is active. If a device is so added or removed, the IEEE 1394 bus will then automatically reconfigure itself for transmitting data between the then existing devices. In the IFE system 200, each SEU would form at least one "node" in association with the IEEE 1394 bus within its zone.

Detailed Description Paragraph Right (28):
Each ZBU receives ATM cells from the ATM network. In accordance with AAL5, ATM and OC-3 protocols 610-612, these ATM cells are assembled as well-known AAL5 Protocol Data Units including IP over ATM packets. The ZBU reformats the data routed from the ATM switch unit by translating the data into an IEEE 1394 compatible datagram having an arbitrary length, commonly referred to as a Service Data Unit ("SDU"), and appending the appropriate IEEE 1394 header to the SDU. This formatting is accomplished by an adaptation layer referred to as an ATM over IEEE 1394 Serial Bus Emulation Layer ("ASEL") 613. ASEL carries the SDU of AAL5 as is, so that ZBU can transfer the data transparently. ASEL provides data fragment/defragment function to adopt difference of packet size. These ASEL functions emulates the condition as if SEU is directly connected to the ATM switch unit, so upper layer software can be used. Readers interested in ASEL type layers can consult Japanese Patent Application (Publication No. P08-082545) by Sony Corporation of Tokyo, Japan.

Detailed Description Paragraph Right (29):
The ZBU further includes an IEEE 1394 data link layer 314 and an IEEE 1394 physical layer 315 supporting data transmissions of approximately 200 Mbps. One implementation of these layers are disclosed in an IEEE publication entitled "P1394 Standard for a High Performance Serial Bus", Draft 8.0v2, dated Jul. 7, 1995.

Current US Cross Reference Classification (4):
725/76

CLAIMS:

1. A digital passenger entertainment system implemented within a vehicle having a plurality of end nodes, comprising:

a first digital network to receive information in an analog format and to transfer the information in a first digital format;

a second digital network to transfer the information in a second digital format supporting asynchronous and isochronous data transfers to each of the plurality of end nodes, the second digital network includes a high speed, serial distribution network that transfers information according to an IEEE 1394 standard; and

a bridge circuit coupled to the first digital network and the second digital network, the bridge circuit to receive the information in the first digital format, to convert the information from the first digital format into the second digital format, and to output the information in the second digital format to the second digital network.

7. A digital passenger entertainment system implemented within a vehicle having a plurality of end nodes, comprising:

a digital Asynchronous Transfer Mode (ATM) network to transmit and to receive at least one ATM cell; and

a digital serial distribution network to transfer digital information in accordance with IEEE 1394 standards to each of the plurality of end nodes; and

a bridge circuit coupled to said ATM network and said serial distribution network, said bridge circuit to receive the at least one ATM cell, to convert the at least one ATM cell into at least one datagram in compliance with IEEE 1394 standards, and to output the at least one datagrams to the serial distribution network.

10. The digital passenger entertainment system according to claim 8, wherein said digital serial distribution network includes a high speed, serial distribution network that transfers information according to an IEEE 1394 standard.

14. A digital passenger entertainment system implemented within a vehicle, comprising:

a digital Asynchronous Transfer Mode (ATM) network to deliver information in a first digital format;

a digital serial network to deliver information in a second digital format support asynchronous and isochronous data transfers, the digital serial network including a high speed, digital serial bus operating in accordance with an IEEE 1394 standard; and

a bridge circuit coupled to the ATM network and the digital serial network, the bridge circuit to convert the information between the first digital format into the second digital format in order to support a transfer of the information between the digital ATM network and the digital serial network.